

***EFFECT OF ENTRAINMENT-MIXING PROCESSES ON SPECTRAL SHAPE:  
PARAMETERIZATION FOR USE IN GCMS***

Yangang Liu and Peter H. Daum

For presentation at the  
IAMAS-Symposium on Dynamical Implications of  
Aerosol-Cloud-Climate Interactions,  
Montreal, Canada  
July 19-29, 2009

**Environmental Sciences Department/Atmospheric Sciences Division  
Brookhaven National Laboratory**  
P.O. Box, Upton, NY  
[www.bnl.gov](http://www.bnl.gov)

**ABSTRACT**

It has been long known to the cloud physics community that turbulent entrainment-mixing processes affect spectral shape of the cloud droplet size distributions. It has been also known to the climate modeling community that entrainment is key to accurately representing convective clouds--- both shallow and deep. So far, various microphysical models (e.g., homogeneous and inhomogeneous mixing), and various entrainment parameterizations have been proposed in literature. However, the connection between entrainment parameterization and microphysical mechanisms/properties, esp., spectral shape, has not been clearly represented, hindering further progress of parameterizing cloud radiative properties and aerosol indirect effects in clouds. This work focuses on quantitative understanding of the effect of entrainment-mixing processes on the relative dispersion of the cloud droplet size distribution (defined as the ratio of standard deviation to mean radius). We will extend our previous work for adiabatic clouds to clouds with different entrainment-mixing mechanisms, and to connect the entrainment parameterization with microphysical mixing mechanisms. Effects of entrainment-mixing processes on evaluation of cloud radiative properties and aerosol indirect effects via spectral dispersion will be explored using the expressions thus derived. Despite not being a focus, effects of entrainment-mixing on droplet concentration and liquid water content, and the overall impact of entrainment-mixing processes via the triad of liquid water content, droplet concentration and relative dispersion will be explored as well.

**NOTICE:** This manuscript has been authored by employees of Brookhaven Science Associates, LLC under Contract No. DE-AC02-98CH10886 with the U.S. Department of Energy. The publisher by accepting the manuscript for publication acknowledges that the United States Government retains a non-exclusive, paid-up, irrevocable, world-wide license to publish or reproduce the published form of this manuscript, or allow others to do so, for United States Government purposes.